REMARKS

Claim 2 had been cancelled and claims 1 and 4 are amended herein without prejudice or disclaimer. Re-examination and reconsideration of the application are requested.

Claims 1-4 were rejected under 35 U.S.C. 103(a) as being unpatentable over Okuda (EP 0398164). This rejection is respectfully traversed, in view of the claims as amended herein and the following remarks.

Claim 1 recites a method of producing a superconductor, comprising forming a superconducting layer on a base layer. The superconducting layer is formed by performing a film deposition at least three times. The film thickness of a superconducting film made in each film deposition is 0.3 μm or less. In addition, the resulting superconducting layer has a layer thickness of 0.75 to 3 μm formed on the base layer. Also, the base layer is composed of Ni, Cr, Mn, Co, Fe, Pd, Cu, Ag or Au or an alloy of at least two of Ni, Cr, Mn, Co, Fe, Pd, Cu, Ag or Au.

Claim 4 recites a superconductor comprising a superconducting layer formed by performing film deposition on a base layer at least three times. Similar to claim 1, the superconducting layer has a layer thickness in the range of 0.75 μm to 3.0 μm and the film thickness of a superconducting film made in each film deposition being 0.3 μm or less. Also similar to claim 1, the base layer is composed of Ni, Cr, Mn, Co, Fe, Pd, Cu, Ag or Au or an alloy of at least two of Ni, Cr, Mn, Co, Fe, Pd, Cu, Ag or Au.

The Okuda reference neither describes nor suggests a method of producing a superconductor as recited in claim 1 or a superconductor as recited in claim 4.

As acknowledged by the Examiner, Okuda does not specifically disclose that each superconducting film is 0.3 μm or less. In addition, Okuda does not disclose a base layer composed of Ni, Cr, Mn, Co, Fe, Pd, Cu, Ag or Au or an alloy of at least two of Ni, Cr, Mn, Co, Fe, Pd, Cu, Ag or Au.

More specifically, the Examiner stated that, while Okuda does not specifically disclose that each superconducting film is about 0.3 μm or less, the Examiner stated that:

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1. one of ordinary skill in the art would have been led to the recited thickness and velocity through routine experimentation to achieve a desired device dimension, device associated characteristics and device density on the finished wafer; and

2. the selection of thickness is obvious because it is a matter of determining optimum process conditions by routine experimentation with a limited number of species of result effective variables.

The Examiner further stated that "the specification contains no disclosure of either the critical nature of the claimed thickness and velocity or any unexpected results arising therefrom."

These grounds of rejection are respectfully traversed. In particular, the specification describes significant advantages available in accordance with the present invention, including advantages relating to a significant increase in the critical current, Ic. For example, the background section of the present application describes prior processes involving deposition of relatively thick layers at one time (including an example involving film thicknesses greater than the claimed range) as providing a relatively small critical current, Ic, and as requiring a relatively large amount of deposition time. (See, e.g., pg. 1, ll. 15-21 and pg. 2, ll. 8-14.)

Embodiments of the present invention are described as providing a superconductor in which the Ic is increased, while minimizing any decrease in the current density Jc. (pg. 2, ll. 19-23.) As further described in the present specification, in a method according to embodiments of the present invention, "the thickness of the superconducting film in each film deposition is 0.3 μm or less." As further described in the present specification, "[w]hen the film thickness exceeds 0.3 μm, it is difficult to cause the superconducting layer to take a sufficient amount of oxygen thereinto during the film deposition, and accordingly the Jc of the superconducting layer decreases." The present specification further explains that "even when the thickness of the superconducting layer is increased, it is difficult to increase the Ic of the superconducting layer. (pg. 5, ll. 12-18.) Thus, the present specification clearly describes advantages available with a process involving deposition of each layer of a superconducting film at 0.3 μm or less

In addition, the present specification describes that "[w]hen the thickness of the superconducting layer (formed by plural films of 0.3 μm or less) exceeds a thickness of 3.0 μm,

the Jc is decreased as the number of times of the film deposition increases." (pg. 8, ll. 13-14.) The specification also describes several examples and comparative examples (see, e.g., table 1 on page 13), where examples processes involving depositions of two or more films of 0.25 μm to form a superconducting layer thickness are compared with comparative examples involving a single deposition of superconducting material to create the full layer thickness in a single deposition. In each case, the example (with a superconducting layer formed by one or more films, each having a film thicknesses of less than 0.3 μm) provided better results than the single deposition of the superconducting layer to the same layer thickness. In particular:

> Example 1 in Table 1 shows a layer thickness of 0.5 μm, formed by two films, each of 0.25 μm and a resulting Ic of 120 A/cm and Jc of 2.4 MA/cm^2. In comparison, Comparative example 2 in Table 1 shows a layer thickness of 0.5 μm, formed by a single deposition of 0.5 μm, where the resulting Ic is 100 A/cm and the Jc is 2.0 MA/cm^2.
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> Example 2 in Table 1 shows a layer thickness of 0.75 μm, formed by three films, each of 0.25 μm and a resulting Ic of 180 A/cm and Jc of 2.4 MA/cm^2. In comparison, Comparative example 3 in Table 1 shows a layer thickness of 0.75 μm, formed by a single deposition of 0.75 μm, where the resulting Ic is 105 A/cm and the Jc is 1.4 MA/cm^2.
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> Example 3 in Table 1 shows a layer thickness of 1.0 μm, formed by four films, each of 025 μm and a resulting Ic of 220 A/cm and Jc of 2.2 MA/cm^2. In comparison, Comparative example 4 in Table 1 shows a layer thickness of 1.0 μm, formed by a single deposition of 1.0 μm, where the resulting Ic is 110 A/cm and the Jc is 1.1 MA/cm^2.
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> Example 4 in Table 1 shows a layer thickness of 1.25 μm, formed by five films, each of 0.25 μm and a resulting Ic of 262.5 A/cm and Jc of 2.1 MA/cm^2. In comparison, Comparative example 5 in Table 1 shows a layer thickness of 1.25 μm, formed by a single deposition of 1.25 μm, where the resulting Ic is 75 A/cm and the Jc is 0.6 MA/cm^2.
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> Example 5 in Table 1 shows a layer thickness of 1.5 μm, formed by six films, each of 0.25 μm and a resulting Ic of 300 A/cm and Jc of 2.0 MA/cm^2. In comparison, Comparative example 6 in Table 1 shows a layer thickness of 1.5 μm, formed by a single deposition of 1.5 μm, where the resulting Ic is 15 A/cm and the Jc is 0.1 MA/cm^2.
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> Example 6 in Table 1 shows a layer thickness of 1.75 μm, formed by seven films, each of 0.25 μm and a resulting Ic of 297.5 A/cm and Jc of 1.7 MA/cm^2. In comparison, Comparative example 7 in Table 1 shows a layer thickness of 1.75 μm, formed by a single deposition of 1.75 μm, where the resulting Ic is 0 A/cm and the Jc is 0 MA/cm^2.
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> Further examples 7-10 in Table 1 show layer thicknesses up to 3.0 μm (formed by multiple films of 0.25 μm each), and resulting measurable Ic and Jc.

> Yet further examples shown in Table 2 (page 17) show that when the film thickness of the superconducting film was increased from 0.3 μm (Example 14) to 0.35 μm (Comparative example 8), the Jc drastically decreased from 2.2 to 1.6 MA/cm^2, which resulted in a decrease of the Ic from 198 to 168 A/cm-width even when the layer thickness of the superconducting layer was increased from 0.9 to 1.05 μm. (see, e.g., pg. 18, ll. 1-6)

Accordingly, it is respectfully submitted that the present specification describes significant advantages available with the presently claimed invention, as compared to prior processes, in which a superconducting layer is formed with a film thickness of greater than 3.0 μm. Furthermore, Okuda neither describes nor suggests such a process. Instead, Okuda appears to relate to conventional processes, in which a layer formed in a single deposition of greater than 0.3 μm is employed. In view of the significant advantages available with embodiments of the present invention and further in view of the lack of any disclosure or suggestion of a process involving a film thickness of 0.3 μm or less or the significant advantages available therewith, it is respectfully submitted that the Examiner has not raised a prima facie case of obviousness over the Okuda reference. Okuda provides no suggestion that would lead one of ordinary skill in the art, through routine experimentation, selection of optimum conditions or otherwise, to form a superconducting layer on a base layer by <u>performing a film deposition at least three times, wherein the film thickness of a superconducting film made in each film deposition is 0.3 μm or less and the superconducting layer having a layer thickness of 0.75 to 3 μm is formed</u>. The rejection of claims 1-4 is, therefore, respectfully traversed.

In addition, claims 1 and 4 are each amended herein to recite that the base layer is composed of Ni, Cr, Mn, Co, Fe, Pd, Cu, Ag or Au or an alloy of at least two of Ni, Cr, Mn, Co, Fe, Pd, Cu, Ag or Au. As described in the present specification (e.g., at pg. 7, ll. 8-12), such metals can provide a biaxial orientation.

When a superconducting layer is formed on a metal substrate, it is desirable to select a metal that can provide a biaxial orientation to the superconducting layer on the metal substrate. In addition, with metal substrates, there is a problem of diffusion of metal into the superconducting material deposited on the base layer.

In contrast to the claimed process, Okuda appears to deposit film on a single crystal substrate. Okuda states the object of their invention is "to incorporate sufficient oxygen even

under a high speed of film formation." However, embodiments of the present invention, where superconducting film depositions are performed on a metal substrate, by performing the film deposition at least two times and employing a film thickness of the superconducting film of 0.3 μm or less in each film deposition, it is possible to prevent the diffusion of a metal from the base into the superconducting layer and, thus, prevent an undesired reaction between the base material and the superconducting material (thus, improving superconducting properties).

Accordingly, it is respectfully submitted that the Okura reference neither discloses nor suggests the invention recited in the present claims. The rejection of claims 1, 3 and 4, as amended herein, is traversed.

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 50-0872. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 50-0872. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 50-0872.

Respectfully submitted,

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